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Critical Care Nursing Interventions and Incidence of Ventilator Associated Pneumonia in the Trauma Population

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by

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Abstract

Ventilator Associated Pneumonia (VAP) in the Trauma Intensive Care Unit is the most commonly encountered infection in the intensive care unit and can be linked to increased morbidity, increased mortality, increased mechanical ventilation days, increased hospital length of stay, and increased cost. A retrospective, correlational study examined the effect of compliance with a ventilator bundle protocol in the Neuro-Trauma Intensive Care Unit on aggregate VAP rates. The study's primary focus was to determine if interventions performed by critical care nurses reduced the incidence of Ventilator Associated Pneumonia (VAP) in the Trauma Intensive Care Unit. The study utilized the retrospective collection of electronic medical records, trauma registry records, and hospital epidemiology records of the sample population.

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Chapter I

Introduction

Trauma centers around the country and around the world now recognize the importance of hospital acquired, or nosocomial infections as they contribute to increasing morbidity and mortality in hospitalized trauma patients. This increase in morbidity and mortality results in significantly increased hospital costs. Ventilator-associated pneumonia (VAP) is the most commonly encountered infection among trauma patients in the intensive care unit, and has been the focus of substantial efforts in prevention, diagnosis, and treatment in this challenging patient population (Shorr & Kollef, 2005).

The Centers for Disease Control (CDC) created a National HealthCare Safety Network (NHSN) primarily to analyze the incidence of various nosocomial infections. The CDC/NHSN publishes yearly annual reports, which outlines details regarding specific rates of the various infections, as well as provides an overall benchmark for infection rates to participating hospitals. The data revealed to researchers that trauma VAP rates have declined steadily over the past seven years. The VAP rate of 15.2 per 1,000 ventilator days in 2004 reduced to a VAP rate of 8.1 per 1,000 ventilator days in 2009, proves that multi-disciplinary team attention and education surrounding this critical issue assists in the reduction. Despite the decline in Trauma Intensive Care Unit (ICU) VAP rates reported by the NHSN, published literature from designated trauma centers world-wide indicates that VAP rates remain high (Rello, Ollendorf, and Oster, 2002).

Direct care givers in the trauma intensive care have many challenges in caring for this population, hence the reason to focus on this preventable complication. Prevention of VAP requires a concerted effort on the part of hospital administrators, physicians, and

intensive care nursing staff. Hospital surveillance programs must be evidenced-based, maintained, updated, and accepted by all direct care givers in the trauma intensive care unit. Intense focus should be on continued education and feedback to the multi-disciplinary team, as this is crucial to further reduction of or maintaining a low VAP rate in the trauma intensive care unit.

Purpose

The purpose of the research study was to determine the effect of interventions performed by critical care nurses on the incidence of Ventilator Associated Pneumonia (VAP) in the Trauma Intensive Care Unit. To reiterate, VAP is the most commonly encountered infection in the intensive care unit, and can be linked to increased morbidity, increased mortality, increased mechanical ventilation days, increased hospital length of stay, and increased cost (Rello et al., 2002). Research on interventions can provide evidence to reduce VAP rates that may be used to educate the multidisciplinary trauma team on appropriateness of care. This study, to determine the effect of interventions performed by critical care nurses on the incidence of Ventilator Associated Pneumonia (VAP), has the potential to yield data that will shape the future development of evidence-based practice guidelines, decrease the complication of VAP in the Trauma Intensive Care Unit (ICU), and improve overall outcomes in the trauma population.

Significance

Ventilator-associated pneumonia (VAP) accounts for a large number of nosocomial infections in the trauma population today (Shorr & Kollef, 2005). Adherence to evidence based practice guidelines for the prevention of VAP will greatly reduce the occurrence of this complication in the ICU setting. Most hospitals have implemented the

vent bundle at this point (as recommended by the CDC) however, many interpret these recommendations differently (Institute of Healthcare Improvement (IHI), 2011). Care guidelines or evidence-based practice orders sets should be agreed upon and used to direct the care delivery of VAP infections. Bedside staff should be involved in the development of such guidelines for successful implementation and adherence. A vent bundle can be defined as a "check list" of clinical interventions that will guide the clinical team in prevention against ventilator associated pneumonias. This checklist includes indicators such as appropriate oral care-swabbing of mouth of intubated patients, chlorhexidine oral rinse, increasing the head of bed in vented patients to greater than 45 degrees if not contraindicated, sedation holidays, deep venous thrombosis prophylaxis, peptic ulcer prophylaxis, frequent suctioning of endotracheal tube, and frequent hand washing. More research is needed in this area; ideally by participating in multi-intuitional studies focused on evidenced based guideline development and variance tracking. Continued vigilance should be maintained in order to positively impact the VAP rate in the Trauma Intensive Care Unit (ICU). This quality indicator should be monitored monthly by the Nurse Manager and Infection Control Specialist with findings shared with physician providers as well as bedside staff.

Research Question

What is the effect of nursing interventions on the incidence of ventilator associated pneumonia (VAP) in the trauma intensive care unit?

Definition of Terms

The following definitions were used in the study of the effect of interventions performed by critical care nurses on the incidence of Ventilator Associated Pneumonia (VAP):

Ventilator Associated Pneumonia (VAP) - pneumonia in a patient intubated and ventilated at the time of or within 48 hours before the onset of the event.

VAP Rate - the number of ventilator-associated pneumonias, per 1,000 ventilator days. In this case, for a particular time period, we are interested in the total number of cases of ventilator-associated pneumonia in the ICU.

Study Design

The study of the effect of interventions performed by critical care nurses on the incidence of Ventilator Associated Pneumonia (VAP) was a retrospective, observational, correlational study which examined facility compliance with a ventilator bundle check list in the Neuro-Trauma Intensive Care Unit and aggregate Trauma ICU VAP rates. The hospital at which the study was conducted, adopted the Institute for Healthcare Improvement's (IHI) ventilator bundle checklist. The primary focus of the study was to determine if interventions performed by critical care nurses reduced the incidence of Ventilator Associated Pneumonia (VAP) in the Trauma Intensive Care Unit. This study design will allow the greatest amount of control possible to examine causality more closely (Burns & Grove, 2009). In this study, the development of and compliance with a ventilator bundle check list served to eliminate other factors that may influence the variables. A data collection tool was developed by the hospital prior to the study of monitor ventilator bundle compliance in the sample population. This ventilator bundle

compliance tool was utilized by the Registered Nurse (RN) case manager during daily multi-disciplinary rounds.

Theoretical Framework

The theoretical framework selected for this study was based on Roy's Adaptation Model (RAM), (2009). Roy is best known for her teaching, scholarly research and writing related to the development of nursing knowledge and practice. The original Roy model, developed in 1977, was based on the works of Von Bertalanffy's general system theory and Helson's adaptation theory as forming the original basis of the scientific assumptions. The assumptions flow from the initial philosophical and scientific perspectives. The philosophical assumptions were based in humanism perspectives of creativity, purposefulness, holism, and interpersonal process relating to the RAM concept. The scientific assumptions were based in systems theory perspectives of holism, interdependence, control processes, information feedback, and complexity of living systems relating to adaptation-level theory assumptions that behavior is adaptive, adaptation is a function of stimuli and adaptation level, adaptation levels are individual and dynamic, and the processes of responding are positive and active (Roy & Andrews, 1999).

In response to the 25th anniversary of the model's publication, Roy restated the assumptions that form the basis of the model and redefined adaptation. Adaptation is defined as "the process and outcome whereby thinking and feeling persons, as individuals or in groups, use conscious awareness and choice to create human and environmental integration" (Roy & Andrews, 1999).

There are four major concepts of the RAM and those are:

1. Humans as adaptive systems as both individuals and groups
2. The environment
3. Health
4. The goal of nursing

According to Roy's model, a person is a bio-psycho-social being in constant interaction with a changing environment. He or she uses innate and acquired mechanisms to adapt. The model includes people as individuals, as well as in groups such as families, organizations, and communities. This also includes society as a whole.

According to Roy (2009), the human adaptive system has inputs of stimuli and adaptation level, outputs as behavioral responses that serve as feedback, and control processes known as coping mechanisms. Roy identifies inputs as stimuli and adaptation level. Stimuli are conceptualized into three classifications: focal, contextual, and residual. The stimulus most immediately affecting the human system is the focal stimulus, and demands the highest awareness from the human system. Contextual stimuli are all other stimuli of the human system's internal and external worlds that can be identified as having a positive or negative effect on the situation. Residual stimuli are external factors whose effects are unclear (Roy, 2009). Along with stimuli, adaptation level is also an important internal input to the system. Adaptation level is the combining of all three stimuli that represent the condition of life processes for the human adaptive system.

For the human adaptive system, complex internal dynamics acts as control processes. Roy presents a unique nursing science concept of control mechanism. These

mechanisms are called regulator and cognator. The transmitters of the regulatory systems are chemical neural or endocrine in nature. The other control subsystem is the cognator subsystem. Cognator control processes are related to the bigger brain functions of perception, information processing, judgment, and emotion. Maximum use of coping mechanism broadens the adaptation level of an individual, and increases the range of stimuli to which a person can positively respond.

The Four Adaptive Modes of Roy's Adaptation Model are physiologic needs, self-concept, role function, and interdependence. The goal of nursing is to promote adaptation in all the various modes, thus contributing to health, quality of life, and dying with dignity, by assessing behaviors and factors that influence adaptive abilities and by intervening to enhance environmental interactions (Roy, 2009).

The nursing process is a decision making method compatible with the practice of nursing using the RAM. The Adaptation Model includes a six-step nursing process. After making a behavioral assessment and nursing judgment, nurses assess stimuli affecting responses, make a nursing diagnosis, set goals, and implement interventions and evaluate to promote adaptation.

The sequence of concepts in the RAM logically followed the concepts of this study to determine if interventions performed by critical care nurses reduced the incidence of VAP in the ICU. In this study, the physiological mode represents the human system's physical responses and interactions with the environment, and is defined as a critically-ill, intubated trauma patient (individual) and total case sample during an 18 month period (group). The RAM's concept input is considered to be the process of mechanical ventilation, and is measured by the total case sample during the 18 month

period. Nursing intervention is nursing compliance with the ventilator bundle as measured by the ventilator bundle compliance tool data. Adaptation in this study is the patient's response to ventilator assisted respiration or VAP, and is measured by the occurrence of VAP in a single patient and VAP rates in the total case sample.

Chapter II

Literature Review

Prior to conducting the study to determine the effect of interventions performed by critical care nurses on the incidence of Ventilator Associated Pneumonia (VAP), a literature review was conducted using the Cumulative Index for Nursing and Allied Health Literature and EBSCO databases. Keywords included: ventilator bundle, Ventilator Associated Pneumonia (VAP), and evidence-based guidelines. The following chapter reports the results of studies found that met the criteria of currency within the past five years and relative to the study.

A prospective, observational study was conducted by DuBose et al. (2010) at a busy urban Level I trauma center to examine the effectiveness of the quality rounds checklist (QRC) in documenting compliance with prophylactic measures for VAP and other intensive care unit complications. Another goal of this study was to determine if improvements in compliance with evidence based practices would prove sustainable beyond the three months of initial examination. The study sample included trauma patients that were admitted to the ICU longer than 48 hours during the 14 month period of using QRC. The results of this study indicated that use of a QRC facilitates sustainable improvement in compliance rates for clinically significant prophylactic measures in a busy Level I trauma ICU. Daily use of QRC to support compliance with evidence based endeavors is a sustainable venture that may significantly improve VAP rates in a busy trauma ICU.

Using a pre-intervention and post intervention observational study design, Babcock et al. (2004) examined whether an educational initiative with clinical staff could

decrease rates of VAP in a regional healthcare system. An educational program emphasizing correct practice was developed for respiratory care practitioners, as well as for ICU nursing staff focusing on prevention of ventilator-associated pneumonia. The program included a self-study module on risk factors for, and strategies to prevent, ventilator-associated pneumonia and education-based in-services. This study was conducted in four regional hospitals over a period of three and one half years. Ventilator-associated pneumonia rates for all four hospitals combined dropped by 46%, from 8.75/1,000 ventilator days in the year prior to the intervention to 4.74/1,000 ventilator days in the 18 months following the intervention. Educational interventions can be associated with decreased rates of ventilator-associated pneumonia in the ICU setting. The study results indicated that involvement of respiratory therapy staff, in addition to ICU nurses, is important for the success of educational programs aimed at the prevention of ventilator-associated pneumonia. This finding was consistent with previous research.

Using a two-phase (before and after), prospective, controlled study design, Quenot et al. (2007) examined whether the use of a nurse-implemented sedation protocol could reduce the incidence of ventilator-associated pneumonia in critically ill patients. The study was done in a French university-affiliated, 11 bed medical intensive care unit. The study sample included patients requiring mechanical ventilation for greater than 48 hours, and who had sedative infusion with midazolam or propofol. Four hundred twenty three participants were enrolled during the two, 2-year phases, separated by a six month interval, during which a multidisciplinary team developed the protocol and underwent training in its use in mechanically ventilated patients. During the first study phase (from May 1999 to May 2001), no protocol was used (control group). During the second phase

(from December 2001 to December 2003), a nurse-implemented sedation protocol was used (protocol group). During the control phase, sedatives were manipulated according to the physician's decision. During the protocol phase, sedatives were manipulated according to the protocol. Study results revealed the incidence of VAP was significantly lower in the protocol group compared to the control group. Therefore, the use of a nurse-implemented sedation protocol decreases the rate of VAP and the duration of mechanical ventilation.

A controlled, two-group comparison study design was used (Chao, Chen, Wang, Lee, & Tsai, 2007) to explore the effect of oral secretion on aspiration and reducing ventilator-associated pneumonia. The subjects used in this study were patients admitted to a 48 bed general ICU in Taipei city. The control group (n=646) received routine oral care (patients admitted from September to December). After the control group was established, the nursing staff was educated regarding the study protocol. The experimental group (n=574) received oral suctioning before each repositioning (patients admitted from March to June). Results revealed that VAP was found in 15% of patients in the control group, and in 4.9% of patients in the experimental group, and that ICU length of stay and duration of mechanical ventilation was decreased in the experimental group. This particular study provides evidence that removal of oral secretions before changing the position of the patient is cost effective in reducing the incidence of VAP.

Using the prospective, randomized study design, researchers (Seguin, Tanguy, Laviolle, Tirel, & Malledant, 2006) examined the effectiveness of a regular oropharyngeal application of povidone-iodine on the prevalence of ventilator-associated pneumonia in patients with severe head trauma. The study was conducted from August

2001 to January 2003 in the 21-bed surgical ICU of the University Hospital of Rennes. The study sample was head injured patients that were expected to need mechanical ventilation for greater than two days. These patients were prospectively randomized into three groups: those receiving nasopharynx and oropharynx rinsing with 20 mL of a 10% povidone-iodine aqueous solution (povidone-iodine group); those receiving nasopharynx and oropharynx rinsing with 60 mL of saline solution (saline group); or those undergoing a standard regimen without any instillation, but with aspiration of oropharyngeal secretions (control group). Within these three groups, a total of 28 cases of ventilator-associated pneumonia were diagnosed. There was a significant decrease in the rate of ventilator-associated pneumonia in the povidone-iodine group when compared with the saline and control groups (three of 36 patients [8%] vs. 12 of 31 patients [39%] and 13 of 31 patients [42%]). The length of stay and mortality in the surgical intensive care unit were not statistically different between the three groups. This study was designed to test the hypothesis that povidone-iodine would reduce the prevalence of VAP in head trauma. In regard to previous studies reporting the prevalence of VAP in head trauma patients, it was calculated that 30 patients in each group would provide a reduction in the prevalence of VAP from 50% to 20%. Major findings of this study revealed the regular application of povidone-iodine, as an oropharyngeal rinse in patients with severe head trauma, reduced significantly the incidence of VAP when compared with standard care however, the efficacy of this strategy must be evaluated in other intensive care units. This finding was consistent with previous research.

A prospective, multi-centered design was used to determine the effectiveness of semi-recumbent positioning in the prevention of VAP (Van Nieuwenhoven et al., 2006).

The study was conducted from January 1999-December 2000 and included patients admitted to four ICUs in three university hospitals in the Netherlands. An inclusion criterion was patients intubated within 24 hours of ICU admission with an expected duration of ventilation of at least 48 hours. Patients in the sample group were randomly assigned to the semi-recumbent position, with a target backrest elevation of 45°, or standard care (i.e., supine position) with a backrest elevation of 10°. Of the sample group, 109 patients were assigned to the supine group and 112 to the semi-recumbent group. Van Nieuwenhoven et al.(2006) found that target semi-recumbent position of 45° was not achieved for 85% of the study time, and these patients more frequently changed position than supine-positioned patients. VAP was diagnosed in 6.5% in the supine group and 10.7% in the semi-recumbent group. There were no differences in numbers of patients undergoing enteral feeding, receiving stress ulcer prophylaxis, developing pressure sores, in mortality rates, or duration of ventilation and intensive care unit stay between the groups. The achieved difference in treatment position did not prevent the development of VAP. This finding was similar to previous research.

A non-experimental, concurrent, observational design study was conducted by Cocanour et al. (2006) to examine ways in which the multi-disciplinary team in the Surgical Trauma Intensive Care Unit (STICU) could decrease the incidence of VAP from occurring in their 20 bed unit. The sample included patients that were admitted to the STICU from November 2002- June 2003. A ventilator bundle that incorporates the Center for Disease Control (CDC) Guidelines for Prevention of Nosocomial Pneumonia was instituted in June of 2002 after VAP rates at this particular hospital reached the National Nosocomial Infection Surveillance (NNIS) 90th percentile. In October 2002, an

intervention, that audited compliance with the ventilator bundle and provided real-time feedback to ICU staff, was started. Results revealed that VAP did not decrease with institution of the ventilator bundle alone. However, VAP did significantly decrease when the ventilator bundle was audited daily and concurrent feedback was shared with caregivers. Study results have implications for the entire multi-disciplinary team. The program must be evidence-based, maintained, and accepted by ICU personnel. Continued education and staff feedback are essential to maintaining a low VAP rate. This finding was consistent with previously reviewed research.

Using a systematic review design, Zilberberg, Shorr, and Kollef (2009) examined the literature to determine the effectiveness of the ventilator bundle to prevent VAP. Studies utilizing the intensive care unit with intubated patients were reviewed. The systematic review found only four studies with a number of issues. According to these researchers, problems exist with the design, flaws in the reporting and results of the studies, including bias. In conclusion, to assure efficient allocation of healthcare resources, rigorous evaluation of optimal strategies for VAP prevention is needed to establish best practices. The review found vent bundle is not a viable quality measure in the intensive care unit at this time. This finding was not consistent with previous research.

The review of the literature revealed research on the effect of rounding semi-recumbernt positioning, (Van Nieuwenhoven et al., 2006), povidone-iodine application (Seguin et al., 2006), oral suctioning (Chao et al., 2007), sedation (Quenot et al., 2007), and education (Babcock et al., 2004). Results of research on the effect of ventilator bundling (Cocanour et al., 2006; Zilberberg et al., 2009) were found to be inconsistent. A

review of the literature regarding interventions to reduce the incidence of VAP revealed a gap in the literature, which warrants additional study to determine if interventions performed by critical care nurses can reduce the incidence of Ventilator Associated Pneumonia (VAP).

Chapter III

Methodology

The study to determine the effect of interventions performed by critical care nurses on the incidence of Ventilator Associated Pneumonia (VAP) in the Trauma Intensive Care Unit was a retrospective, observational, descriptive study.

Setting

The study to determine the effect of interventions, performed by critical care nurses on the incidence of VAP, was conducted at a large regional tertiary medical center in Western North Carolina. This hospital is a 756 bed, level II trauma center admitting approximately 3,200 trauma patients annually. The hospital has approximately 7,000 employees and sustains a hospital census on average of 85%. The primary study setting was in a combined Neurosurgical and Trauma intensive care unit which has 16 staffed beds. Staffing in this unit consists of only registered nurses and certified nursing assistants that provide support to RNs. This specialty intensive care unit's census has an average occupancy rate of 96%. Patients admitted to this unit are either critically injured trauma patients or patients with serious neurological conditions that require intense monitoring by the care team.

Sample Population

The sample for the study to determine the effect of interventions, performed by critical care nurses on the incidence of VAP, included all patients admitted to the ICU from January 2011 to June 2012. A retrospective chart review was done to collect data regarding ventilator days, compliance with vent bundling, and incidence of VAP.

Inclusion criteria for the study included:

1. Patient hospitalized with blunt or penetrating trauma from January 2011- June 2012
2. Adult (16 or over)
3. Confirmed diagnosis of VAP
4. On mechanical ventilation longer than 48 hours prior to VAP diagnosis.

No one was excluded from the study based on race or gender.

Instruments

The Ventilator Bundle Check List (VBCL) was developed by the healthcare facility to monitor ventilator bundle compliance in the sample population. The use of the VBCL was established previous to the study. Data was collected by the healthcare facility from reports from the RN case manager, who monitored RN compliance with the ventilator bundling during daily multi-disciplinary rounds.

Ethical Considerations

Prior to conducting the study to determine the effect of interventions performed by critical care nurses on the incidence of VAP, the researcher obtained permission from the Internal Review Board (IRB) for the University, as well as from the healthcare facility. In the analysis phase, all data was stripped of patient identifiers and was reported in aggregate. The data collected was entered by the researcher into a secure, password protected database created and maintained by the researcher. All patient identifiers were removed from the data prior to entry into the database and reported as aggregate data only.

Data Collection Method

This study consisted of a retrospective collection and review of electronic medical records, trauma registry records, and hospital epidemiology records for the sample population, as well as review of the data collection tool for the Neuro-Trauma Intensive Care Unit ventilator bundle compliance.

Data Analysis

Data was entered into a personal computer by the primary researcher. Descriptive statistics were performed utilizing the Statistical Package for the Social Sciences, Version 19. Frequencies and measures of central tendencies were performed to determine the effect of interventions performed by critical care nurses on the incidence of Ventilator Associated Pneumonia (VAP) in the Trauma Intensive Care Unit.

Chapter IV

Results

The sample for the study to determine the effect of interventions performed by critical care nurses on the incidence of VAP included 1,987 ventilated patients in the Neuro-Trauma intensive care unit. The study duration was 18 months (January 2011-June 2012). Aggregate data related to ventilator bundle compliance and ventilator associated pneumonia per quarter for the 18 months of the study period can be found in Table 1 and 2 below.

Table 1

Ventilator Bundle Compliance over the six quarters.

Compliance Indicators	1st Qtr 2011	2nd Qtr 2011	3rd Qtr 2011	4th Qtr 2011	1st Qtr 2012	2nd Qtr 2012
Head of Bed elevated	324	337	450	433	252	186
Peptic Ulcer Disease Prophylaxis	320	336	444	432	250	176
Deep Vein Thrombosis Prophylaxis	323	337	448	432	252	177
Sedation holiday	321	333	441	420	254	187
Oral care	319	338	422	410	242	186
Total number of vented patients	324	338	450	433	255	187
Total number compliant with all indicators	316	329	416	395	236	176
Percent total compliance	97	97	92	91	93	94

Table 2

Ventilator Associated Pneumonia over the six quarters.

	1st Qtr 2011	2nd Qtr 2011	3rd Qtr 2011	4th Qtr 2011	1st Qtr 2012	2nd Qtr 2012
Number of VAP occurrences	3	1	3	2	2	3
Number of Ventilator Days	631	516	580	685	427	458
VAP Rate (Number of VAP/Ventilator Days x 1000)	4.75	1.94	5.17	2.92	4.68	6.55

VAP Occurrence

It is important to note that all five of the compliance indicators must be performed in order to be compliant with the ventilator bundle, as determined by IHI's "all or none" definition. Ventilator Bundle Compliance was overall quite good during the study period, varying from 91-97% compliance. Results of data analysis revealed that each quarter the ICU unit exceeded the target, as determined by their institutional quality and safety committee. Each individual indicator of compliance was also analyzed to identify where staff had improved the most during the course of the study. Results showed that nursing staff was least compliant with oral care, only completing this 96% of the time. Staff was slightly more compliant with providing a sedation holiday for affected patients and documenting this occurrence (98.4%), providing peptic ulcer disease prophylaxis (98.5%), and providing deep vein thrombosis prophylaxis (99.1%). The indicator the staff was most compliant with was elevating the head of the bed (99.7%). There were five patients hospitalized in the ICU during the study period, whose clinical condition warranted the HOB to remain flat. PUD indicator was followed 98.5% of the time. During the six quarters or 18 months of the study, adherence to the ventilator bundle checklist was extremely good for this unit, as the institutional established threshold was 90%. (Figure 1)

VAP occurrence over the study period ranged from one to three per quarter (M=2.33, SD=.81). , averaging 2.33 per quarter. (Figure 2) The number of days patients were artificially ventilated ranged from 427 to 685 per quarter (M = 549.5, SD = 100.43). The VAP rate was determined by dividing the incidence of VAP by the number of

ventilated days multiplied by 1000. During the study the VAP rate per quarter ranged from 1.94 to 6.55 (M=4.33, SD=1.65). (Figure 3)

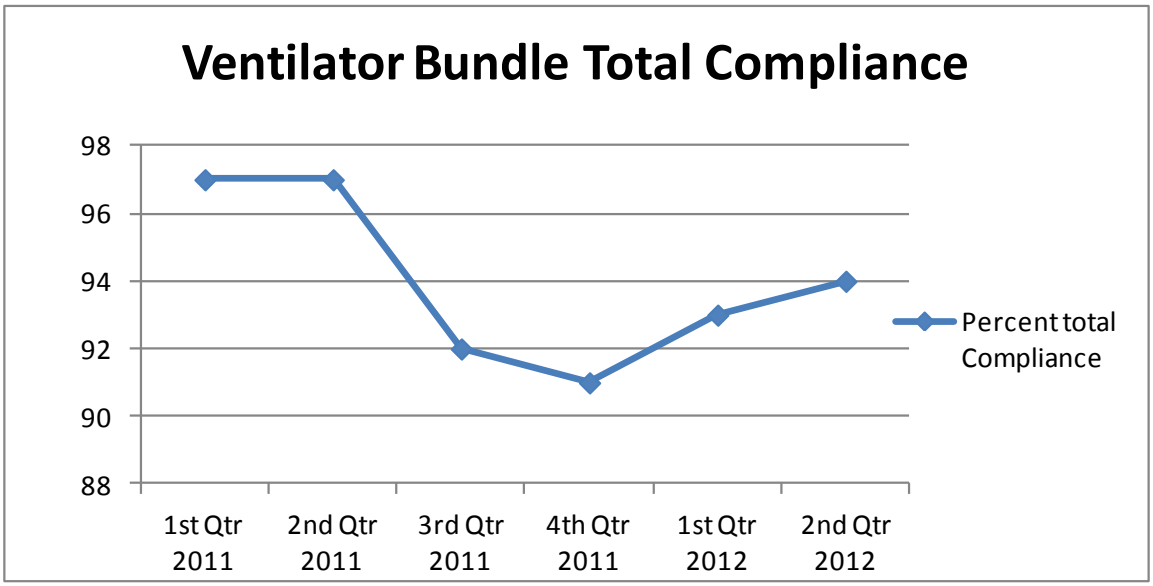

Figure 1. Total Ventilator Bundle Compliance over the six quarters.

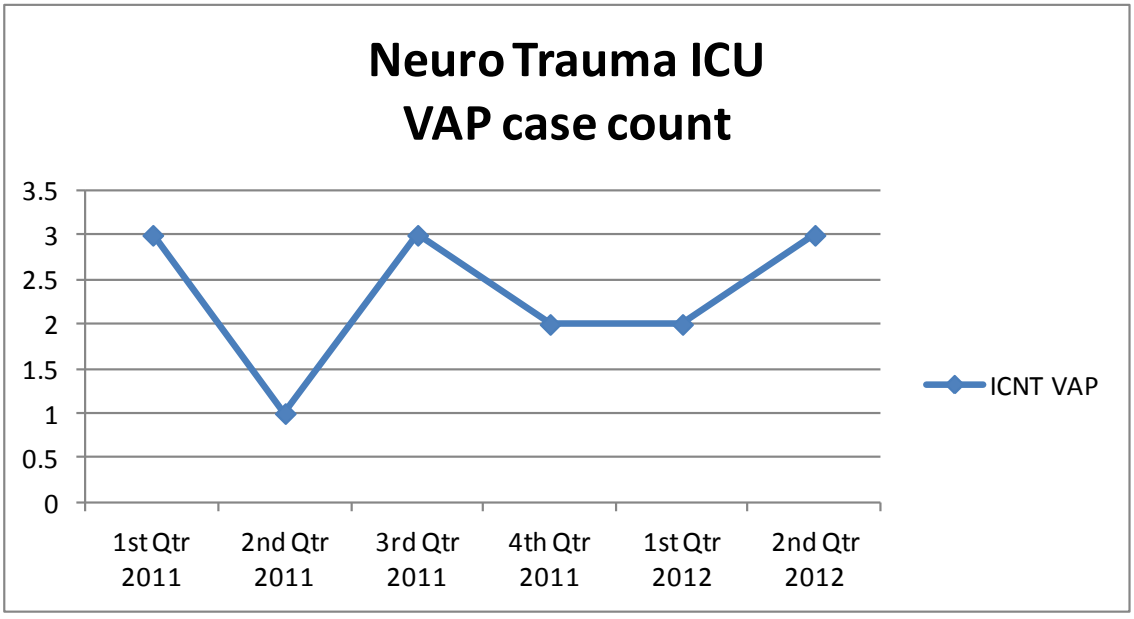

Figure 2. Occurrence of Ventilator Associated Pneumonia over the six quarters.

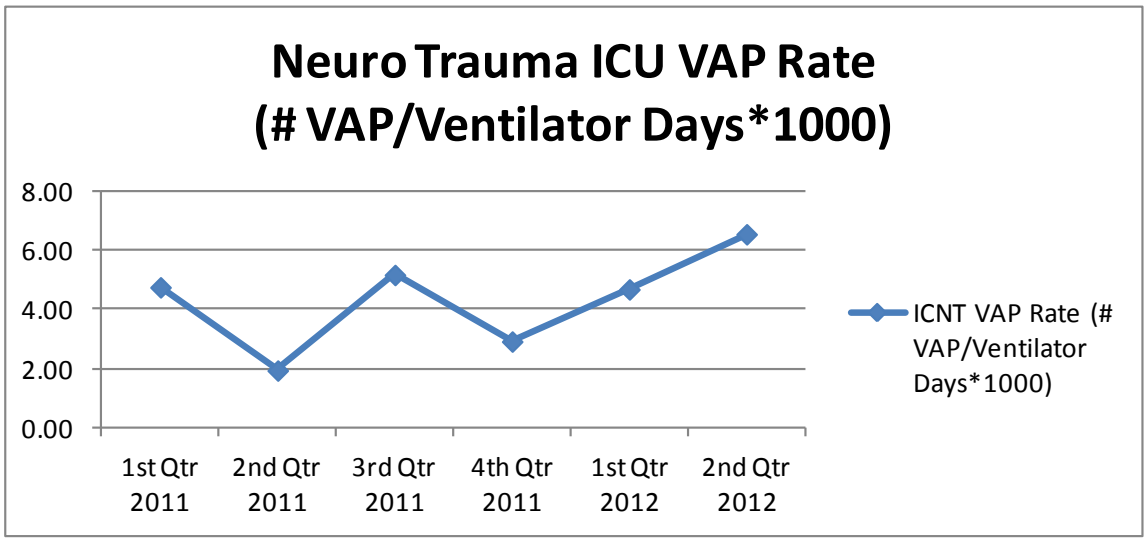

Figure 3. Rate of Ventilator Associated Pneumonia over the six quarters

Chapter V

Discussion

Significance of the Findings

The primary aim of this study was to determine effects of nursing interventions on the incidence of ventilator associated pneumonia (VAP) in the trauma intensive care unit. The duration of the study was six quarters or 18 months. The study was isolated to a combined Neurosurgical/Trauma Intensive Care Unit in Western North Carolina. As a reporting convenience, the researcher analyzed quarterly data instead of monthly data. The study period was from Quarter 1 of 2011 and ended after Quarter 2 of 2012.

IHI's "All or none" compliance concept was adopted for purposes of this study (e.g., Registered Nurses must be compliant with all indicators of the ventilator bundle for compliance to occur). Throughout the study, ventilator bundle compliance varied from 91% to 97% compliance. Quarterly compliance decreases after the 2nd Quarter in 2011 due to RN turnover in this particular unit and the use of traveling staff nurses. Significant educational initiatives were launched after leadership noted non-compliance with this particular checklist, and other evidence based guidelines pertaining to this patient population. As of the 2nd Quarter in 2012, ventilator bundle compliance had increased to 94% compliant. VAP occurrence fluctuates during the reporting period from only one confirmed VAP case to three confirmed VAP cases. Consequently, it was only during the 2nd quarter of 2011 that low VAP occurrence coincided with high ventilator bundle compliance. VAP occurrence variation is noted throughout the remaining study period. Although it cannot be proven with this data, it may be suggested that the ventilator bundle may in fact be suppressing VAP infectious rates in this particular unit. Additional

research would be beneficial to determine effectiveness of these interventions on VAP. It may also be beneficial to "uncouple" the bundle to determine effectiveness of each individual indicator.

Although VAP has multiple risk factors, nursing interventions and continued hyper vigilance can possibly reduce the incidence of this disease.

Implications for Nursing Practice

The effects of VAP on morbidity, mortality, length of hospital stay, and cost are enormous. Education plays a key role in the management of patients with VAP. Nursing management/leadership should consider utilization of self-study education modules on the nursing care of patients at risk for VAP as research has indicated it can decrease the rate of this type of pneumonia as well as decrease the number of days of mechanical ventilation.

Nursing leadership should be responsible for ensuring appropriate education is provided as needed to new caregivers. Managers and supervisors should also verify that ventilator bundle checklists and compliance protocols are completed and appropriately followed to prevent VAP and other complications of intubation and mechanical ventilation. As evidenced by the data presented, a simple, yet cost-effective way to ensure elevation of patient head of bed and other indicators on ventilator bundle compliance checklist is through daily nursing audits. An "all or none" approach was taken in the study facility, which essentially means if all ventilator bundle indicators are not followed, the care team is non-compliant. Standardized orders or pathways proved to be friendly reminders to healthcare providers about the importance of interventions to prevent VAP in this setting.

Limitations of the Study

There were no known limitations to this study. Generalizability was restricted given the study was performed in a single neurosurgical-trauma intensive care unit. Study assumptions included:

- The Sample represented the population being studied
- Ventilator bundle compliance check lists were completed daily

Recommendations for Future Research

There is clearly a need for a follow-up study, given the many challenges encountered during this 18 month period with staff turnover and utilization of traveling staff nurses. It is recommended that the study be replicated in a more stable unit over a longer period of time.

Importance of the Findings for Nursing

VAP, although often preventable, has a large impact on morbidity and mortality. Nurses play a key role in preventing VAP. Many of the interventions are part of routine nursing care. Education for all healthcare providers should focus on the risk factors for VAP and on preventive measures. In order to further decrease the incidence of VAP, protocols and monitoring tools must be developed and followed. Several opportunities to reduce the incidence of VAP are immediately available to the clinician. Many are no-cost or minimal-cost interventions, and should be implemented as part of routine care protocols as outlined above. VAP increases patients' care time, length of stay, and morbidity rate. Consequently, all these negative impacts will increase the health care costs. Since intubated patients are having a high risk of acquiring VAP, preventive measures are the key. Care of the critically ill should be directed at applying interventions

that reduce mortality, minimize morbidity, shorten the length of stay, and reduce cost. Reducing VAP through the simple measures does exactly that. It is recommended that the clinician's practice include; elevation of the head to at least 30°, minimization of sedation, sedation vacations, administration of a proton pump inhibitor when prophylaxis is indicated, deep venous thrombosis prophylaxis when indicated, oral care as described above, and of course excellent hand hygiene. VAP is not a new diagnosis. Education and research on the prevention of this life-threatening problem should be ongoing in order to improve overall quality by reducing future morbidities, mortalities, length of stay, and hospital cost.

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